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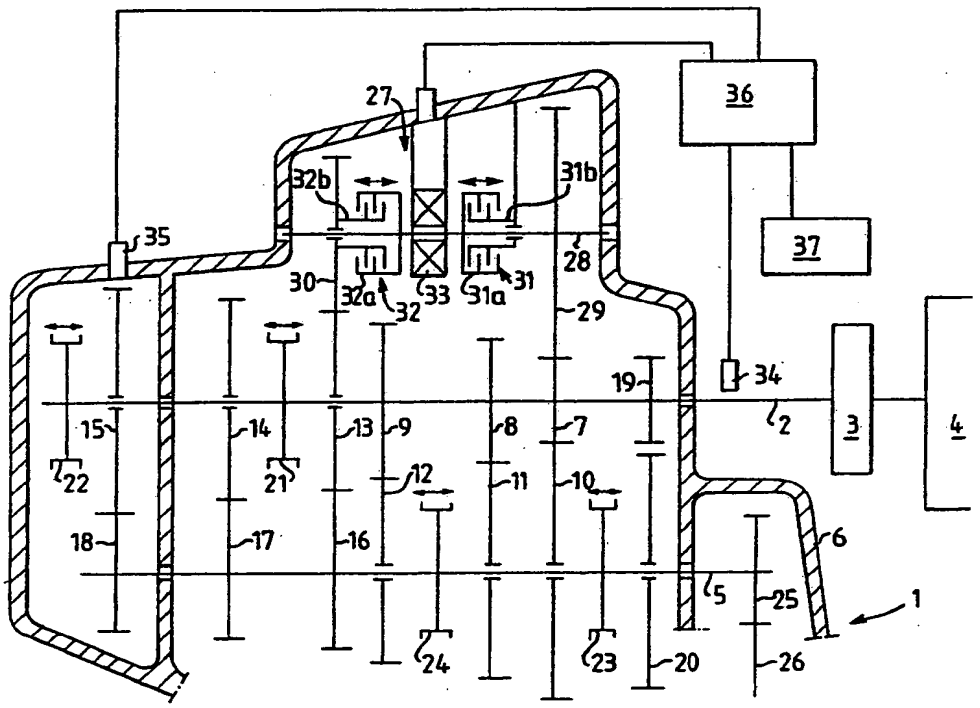


(57) Abstract

A gearbox (1) for motor vehicles has an input (2) and an output (5) shaft, where gear wheels (7-20) are in engagement with each other, at least one gear wheel on each shaft being rotatably mounted and capable of being locked on its shaft by means of a clutch member (21-24). Both these shafts are coupled to a synchronisation arrangement (27) common to a number of gears and by means of which the input shaft (2) can be braked or accelerated to a speed necessary for the chosen gear.

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# GEARBOX FOR MOTOR VEHICLES

The present invention relates to a gearbox for motor vehicles, with an input shaft which has gear wheels in engagement with gear wheels on an output shaft which is parallel to the input shaft, at least one of the gear wheels on each shaft being rotatably mounted on its shaft and capable of being locked on its shaft by means of a clutch member.

In gearboxes for motor vehicles it is customary to have a separate synchronisation arrangement for each gear in order to obtain the necessary synchronisation between input and output shaft. Thus, with an increasing number of gears, an ever increasing length of gearbox is required, which can be inconvenient with respect to, inter alia, space, complexity and weight.

In certain types of gearboxes it is previously known to reduce the number of synchronisation arrangements and to use one synchronisation arrangement common to a number of gears. One such type of gearbox is described in US-A-3,386,302, for example, where an input shaft can be brought into engagement, via fixed gear wheels on a number of intermediate shafts, with gear wheels on an output shaft by means of axial displacement of an engagement element which, via a synchronisation arrangement, can be connected to an output shaft. Upon changing gear, the entire synchronisation arrangement is displaced axially. Such a gearbox requires considerable space in the axial direction, particularly in the case of a large number of gears.

In another type of gearbox according to SE-C-458,846, there are two concentric input shafts which each drive a respective intermediate shaft, of which one has a central synchronisation arrangement, where either of two different-sized gear wheels can be brought into engagement with the one input shaft. The synchronisation arrangement requires axial space in the gearbox, and the gearbox itself is of a complex type which is best suited for heavy vehicles.

The aim of the invention is to provide a gearbox of the type mentioned in the introduction and customarily used for passenger cars, which permits a more compact design in the axial direction so that a shorter gearbox can be

obtained, or alternatively a larger number of gears can be accommodated in one gearbox of a certain length. In addition, it is desirable to achieve a rapid and reliable synchronisation between the input and output shaft of the gearbox in all gears.

According to the invention, this aim is achieved by virtue of the fact that both the input and the output shaft are coupled to a synchronisation arrangement which is independent of said clutch members and common to a number of gears, by means of which synchronisation arrangement the input shaft, upon gear changing, can be braked independently of the output shaft or accelerated as a function of the output shaft, to a speed necessary for the chosen gear.

Such a synchronisation arrangement can include, on the one hand, a first gear wheel which is driven by the input shaft and which cooperates with a first friction clutch intended for braking the input shaft via the first gear wheel, and on the other hand a second gear wheel which is driven by the output shaft and which can be coupled, by means of a second friction clutch, to the first gear wheel in order to accelerate the input shaft via the latter. By manoeuvring of the suitable clutch, good synchronisation can be obtained both on changing up and changing down gear.

The first and the second gear wheel can advantageously be arranged on a common shaft parallel to the input shaft, one of the two gear wheels advantageously being mounted in a rotationally fixed manner on the shaft, while the second is rotatably mounted on the shaft. In this case the two friction clutches can advantageously be situated between the first and the second gear wheel. This facilitates assembly of a manoeuvring device common to both clutches.

Further features and advantages of the invention will emerge from the following description in which reference is made to an exemplary embodiment illustrated in the attached drawing, in which the figure shows a diagrammatic longitudinal cross-section through a six speed gearbox according to the invention.

The drawing shows diagrammatically a gearbox 1 which with its input shaft 2 is coupled via a conventional clutch 3 to an engine 4. An output shaft 5 is parallel to the input shaft 2 and, like the latter, is rotatably mounted in the housing 6 of the gearbox via suitable bearings (not shown). The gearbox shown has six forward gears and one reverse gear, with the highest gear situated on the far left in the drawing.

The input shaft 2 is provided on the one hand with gear wheels 7, 8 and 9 which are arranged in a rotationally fixed manner and are in engagement in each case with gear wheels 10, 11 and 12, respectively, arranged rotatably on the output shaft 5, and on the other hand with rotatably arranged gear wheels 13, 14 and 15 which are in engagement in each case with gear wheels 16, 17 and 18, respectively, arranged in a rotationally fixed manner on the output shaft 5. These twelve gear wheels 7-18 together form the six different forward gears. On the input shaft 2 there is also a rotationally fixed gear wheel 19 which, via a gear wheel (not shown), is in engagement with a gear wheel 20 arranged rotatably on the output shaft 5 and together with this gear wheel 20 forms a reverse gear.

For locking the rotatably arranged gear wheels on the respective shaft, there are a number of clutch sleeves of a type known per se which, by means of axial displacement, can be brought into engagement with associated gear wheels. Thus, there is arranged between the gear wheels 13 and 14 a clutch sleeve 21 which, by means of axial displacement, can be brought into engagement with either gear wheel in order to lock the latter rotationally fixed on the shaft. In a corresponding manner, a clutch sleeve 22 is associated with the gear wheel 15, and a clutch sleeve 23 with the gear wheels 20 and 10, and a clutch sleeve 24 with the gear wheels 11 and 12. In all these clutch sleeves and gear wheels there are no conventional individual synchronisation arrangements, which means that the length of the gearbox can be reduced or that more gears than normal can be accommodated on the given length.

The output shaft 5 is also provided with a rotationally fixed output gear wheel 25 for driving additional parts in a vehicle transmission, here indicated by a gear wheel 26.

In order to permit a desired synchronisation between the input shaft 2 and the output shaft 5 when changing gear, a synchronisation arrangement 27 is provided by means of which the input shaft 2 can be braked or accelerated. This synchronisation arrangement includes a shaft 28 mounted in the housing 6 and parallel to the input shaft 2, on which shaft 28 there is, on the one hand, a rotationally fixed gear wheel 29 and on the other hand a rotatably arranged gear wheel 30. In the drawing, the shaft 28 is situated in the same plane as the shafts 2 and 5, but in reality it may advantageously be arranged in a plane other than that of the shafts 2 and 5. The gear wheel 29 is in engagement with the gear wheel 7 arranged rotationally fixed on the input shaft 2 and is larger than the gear wheel 30 which, via the rotatably mounted gear wheel 13 on the input shaft 2, is in engagement with the rotationally fixed gear wheel 16 on the output shaft 5. The gear wheel 30 can of course be coupled in another way to the output shaft 5, for example via a separately mounted gear wheel instead of gear wheel 13.

The synchronisation arrangement 27 furthermore includes a first and a second friction clutch 31 and 32, respectively. These each have a first part 31a and 32a, respectively, rotationally fixed on the shaft 28 but mounted axially displaceably. The other part 31b of the clutch 31 is fixed in the housing 6, while the other part 32b of the clutch 32 is fixed on the gear wheel 30 and can thus rotate together with the latter.

For manoeuvring the two clutches 31 and 32 situated between the gear wheels 29 and 30, a manoeuvring device 33 is situated between them. This may consist, if appropriate, of two manoeuvring parts, one for each clutch. The manoeuvring device 33 is designed in such a way that only one clutch at a time can be brought into engagement. The clutches are advantageously of the disc type in order to provide gentle engagement, but other designs are also conceivable. According to the example shown, the manoeuvring can advantageously be effected by electromagnetic means, but hydraulic manoeuvring is also conceivable. Such manoeuvring devices are well known and do not therefore need to be described in detail here. In the normal position, the two clutches are disengaged.

The clutch 31 is used to brake the input shaft 2 when changing up gear, whereas the clutch 32 is used in order to accelerate the input shaft 2 when changing down gear. The function is as follows:

When gear changing is to be carried out, the input shaft 2 is disengaged from the engine via the clutch 3, and the gearbox is thus in the neutral position according to the drawing, i.e. the input shaft and the output shaft are not in engagement with each other. When the gear is to be changed up, i.e. when the input shaft 2 is to be made to rotate more slowly than before, braking of the input shaft 2 is required. This is achieved by activating the clutch 31, which brakes the shaft 28 and thus, via the gear wheels 29 and 7, also the input shaft 2. The shaft 28 rotates freely relative to the gear wheel 30 since the clutch 32 is not activated.

When, instead, the gear is to be changed down, i.e. when the input shaft 2 is to be made to rotate more quickly than before, acceleration of the input shaft 2 is required. This is achieved by activating the clutch 32 so that the shaft 28 is forced to follow the gear wheel 30 in its rotation. Since the gear wheel 30 is driven by the output shaft 5 via the gear wheels 16 and 13, the gear wheel 29 in this way comes to accelerate the input shaft 2 via the gear wheel 7. For this to be possible, the gear wheels 16, 30, 29 and 7 must of course be mutually adapted so that an increase in speed of the input shaft 2 is possible.

An equivalent function is obtained if, for example, the gear wheel 29 is instead mounted rotatably on the shaft 28 and, for braking, is acted upon by a clutch connected to the housing, while a second clutch can join the gear wheel 29 to the shaft 28, which then supports the gear wheel 30 in a rotationally fixed manner.

The speed of the input shaft 2 and the output shaft 5 is detected by electrical sensors 34 and 35, respectively, which are coupled to a control unit 36, which in turn is coupled to the manoeuvring device 33 and via the latter controls the clutches 31 and 32. In this way, rapid and reliable synchronisation of the shafts 2 and 5 can be obtained at different gears, so that the clutch sleeve in question can be brought without any problem into engagement with the gear wheel in question for the purpose of rapid and reliable gear changing.

The gear changing can be effected, if appropriate, with the aid of a gear change servo 37 which is advantageously controlled by the control unit 36. When the desired gear is engaged, the clutch 3 is brought once again into engagement.

In order to facilitate the synchronisation, it is expedient for the control unit to obtain information, for example via the manoeuvring column of the gearbox, on which gear is engaged at a given time, on the one hand, and, on the other hand, which gear should be engaged. An accurate speed adjustment can be carried out quickly in this way, which permits rapid and accurate gear changing.

## Patent Claims

1. Gearbox for motor vehicles, with an input shaft (2) which has gear wheels (7-9, 13-15, 19) in engagement with gear wheels (10-12, 16-18, 20) on an output shaft (5) which is parallel to the input shaft, at least one of the gear wheels on each shaft being rotatably mounted on its shaft and capable of being locked on its shaft by means of a clutch member (21-24), *characterised* in that both the input (2) and the output (5) shaft are coupled to a synchronisation arrangement (27) which is independent of said clutch members (21-24) and common to a number of gears, by means of which synchronisation arrangement the input shaft (2), upon gear changing, can be braked independently of the output shaft or accelerated as a function of the output shaft, to a speed necessary for the chosen gear.

2. Gearbox according to Claim 1, *characterised* in that the synchronisation arrangement (27) includes a first gear wheel (29) which is driven by the input shaft (2) and which cooperates with a first friction clutch (31) intended for braking the input shaft via the first gear wheel (29).

3. Gearbox according to Claim 2, *characterised* in that the synchronisation arrangement (27) also includes a second gear wheel (30) which is driven by the output shaft (5) and which can be coupled, by means of a second friction clutch (32), to the first gear wheel (29) in order to accelerate the input shaft (2) via the latter.

4. Gearbox according to Claim 3, *characterised* in that the second gear wheel (30) is driven by the output shaft (5) via a gear wheel (13) mounted rotatably on the input shaft (2).

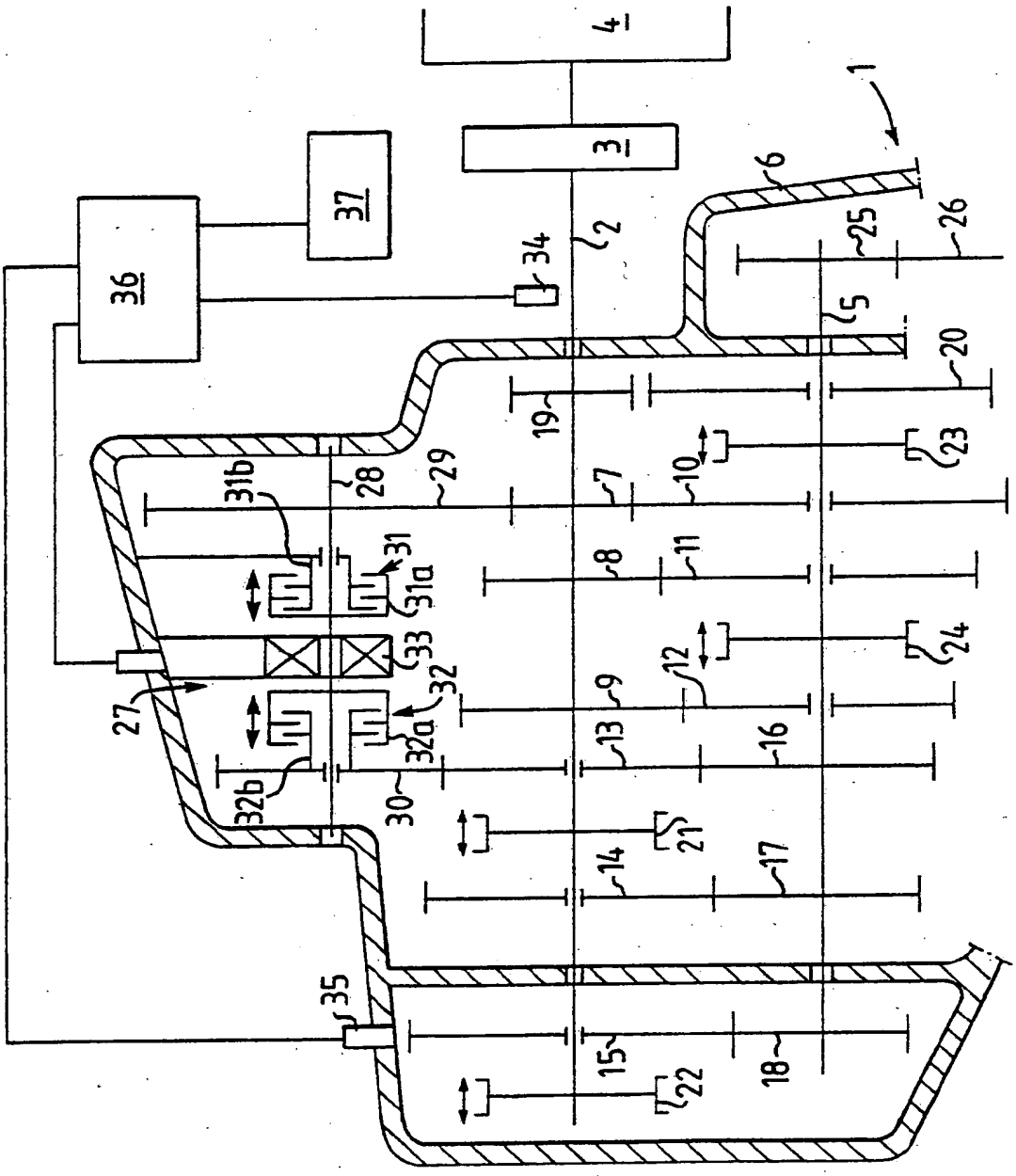
5. Gearbox according to Claim 3 or 4, *characterised* in that the first (29) and the second (30) gear wheel are arranged on a common shaft (28) parallel to the input shaft (2), one of the two gear wheels (29, 30) being mounted in a rotationally fixed manner on the shaft (28), while the other is rotatably mounted on the shaft.

6. Gearbox according to Claim 5, *characterised* in that the two friction clutches (31, 32) are situated between the first and the second gear wheel (29, 30) and are intended to be actuated one at a time, a manoeuvring device being associated with each clutch, advantageously a manoeuvring device (33) common to both clutches.

7. Gearbox according to Claim 6, *characterised* in that the friction clutches (31, 32) are of the disc type.

8. Gearbox according to any one of Claims 3-7, *characterised* in that the first gear wheel (29) is larger than the second gear wheel (30).

9. Gearbox according to any one of Claims 6-8, *characterised* in that sensors (34, 35) for detecting the speed of the input (2) and output (5) shaft, respectively, are coupled to a control unit (36) which is designed to receive information on the desired gear and, as a function thereof, to control the manoeuvring device (27) of the clutches in order to obtain the desired synchronisation speed of the input shaft (2).



# INTERNATIONAL SEARCH REPORT

International Application No PCT/SE 90/00852

## I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC5: F 16 H 3/12

## II. FIELDS SEARCHED

| Minimum Documentation Searched[7] | |
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| Classification System | Classification Symbols |
| IPC5 | F 16 H; B 60 K |

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched[8]

SE,DK,FI,NO classes as above

## III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

| Category * | Citation of Document,[11] with indication, where appropriate, of the relevant passages[12] | Relevant to Claim No.[13] |
|---|---|---|
| X | WO, A1, 8505427 (J.M. VOITH GMBH) 5 December 1985, see the whole document -- | 1 |
| A | US, A, 3386302 (P.G. IVANCHICH) 4 June 1968, see the whole document -- | |
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## IV. CERTIFICATION

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# ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. PCT/SE 90/00852

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| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
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| | | JP-A- 63203951 | 88-08-23 |
| | | SE-A- 8700583 | 88-08-14 |
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